

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.

(19)



Europäisches Patentamt

European Patent Office

Offic européen des brevets



(11)

EP 0 748 885 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:

18.12.1996 Bulletin 1996/51

(51) Int Cl. C30B 15/10

(21) Application number. 96304342.7

(22) Date of filing 10.06.1996

(84) Designated Contracting States:  
DE FR GB IT

(30) Priority 14.06.1995 US 490465

(71) Applicants

- MEMC Electronic Materials, Inc.  
St. Peters, Missouri 63376 (US)
- GENERAL ELECTRIC COMPANY  
Cleveland, Ohio 44117 (US)

(72) Inventors

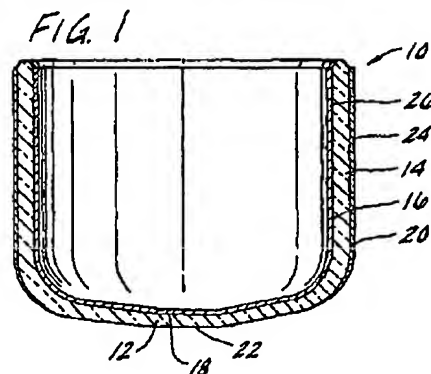
- Hansen, Richard L.  
St. Louis, Missouri 63146 (US)
- Shelley, Robert D.  
Cleveland, Ohio 44117 (US)

- Drafall, Larry E.  
St. Charles, Missouri 63303 (US)
- McCutchan, Robert M.  
Lake St. Louis, Missouri (US)
- Holder, John D.  
Lake St. Louis, Missouri (US)
- Allan, Leon A.  
Grover, Missouri 63040 (US)

(74) Representative: Eyles, Christopher Thomas  
W.P. THOMPSON & CO.  
Celcon House  
289-293 High Holborn  
London WC1V 7HU (GB)

(54) Crucible for improved zero dislocation single crystal growth

(57) A crucible in which a semiconductor material is melted and held during a crystal growing process. The crucible includes a body of vitreous silica having a bottom wall and a sidewall formation extending up from the bottom wall and defining a cavity for holding the molten semiconductor material. The sidewall formation has an inner and an outer surface. A first devitrification promoter on the inner surface of the sidewall formation is distributed such that a first layer of substantially devitrified silica is formed on the inner surface of the crucible which is in contact with the molten semiconductor material when the semiconductor material is melted in the crucible during the crystal growing process. A second devitrification promoter on the outer surface of the sidewall formation is distributed such that a second layer of substantially devitrified silica is formed on the outer surface of the crucible when the semiconductor material is melted in the crucible during the crystal growing process. The first substantially devitrified silica layer is such that it promotes uniform dissolution of the inner surface and in so doing significantly reduces the release of crystalline silica particulates into the molten semiconductor material as a crystal is pulled from the molten semiconductor material. The second substantially devitrified silica layer is such that it reinforces the vitreous silica body.



EP 0 748 885 A1

EP 0 748 885 A1



European Patent  
Office

EUROPEAN SEARCH REPORT

Application Number  
EP 96 30 4342

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO-A-94 24505 (QUARTZ & SILICE ;BALIAN PIERRE (FR); RIMLINGER SERGE (FR); TROUVÉ) 27 October 1994 * page 1, line 9 - page 9, line 24 *	1-3,6, 11,12	C30B15/10
X,D	US-A-4 102 666 (BAUMLER PETER ET AL) 25 July 1978 * column 3, line 43 - column 8, line 86 *	1,4,7, 11,12	
X	DE-A-19 59 392 (WACKER CHEMITRONIC GMBH-ELEK) 3 June 1971 * claims 1,3 *	1-3	
A	EP-A-0 463 543 (SHINETSU QUARTZ PROD) 2 January 1992 * claim 1 *	13	
A	US-A-5 053 359 (LOXLEY TED A ET AL) 1 October 1991 * abstract *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			C30B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		13 September 1996	Flink, E
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone  Y : particularly relevant if combined with another document of the same category  A : technological background  O : non-written disclosure  P : intermediate document</p> <p>Y : theory or principle underlying the invention  K : earlier patent document, but published on, or after the filing date  D : document cited in the application  L : document cited for other reasons  A : member of the same patent family, corresponding document</p>			

EPF FORM 150 (04/96) (P)

## XP-002251919

AN - 1988-319477 [45]  
AP - JP19870070214 19870326; JP19870070214 19870326; [Based on J63236723 ]  
CPY - SHIN-N  
DC - E36 L01 L03 U11  
DR - 1666-P 1694-U  
FS - CPI;EPI  
IC - C03B20/00 ; C30B15/10 ; C30B35/00 ; H01L21/22  
MC - E31-P06A L01-A05 L04-D05  
- U11-C02A1  
M3 - [01] B114 C810 M411 M720 M903 M904 M910 N104 Q452 Q454; R01666-P;  
3102-R 1678-D  
PA - (SHIN-N) SHIN-ETSU SEKIEI KK  
PN - JP63236723 A 19881003 DW198845 004pp  
- JP6008181B B2 19940202 DW199408 C03B20/00 000pp  
PR - JP19870070214 19870326  
XA - C1988-141160  
XIC - C03B-020/00 ; C30B-015/10 ; C30B-035/00 ; H01L-021/22  
XP - N1988-242260  
AB - J63236723 On the outer surface of the glass prods. contg. 0.2- ppm or less each of Na and K, and OH content 10 ppm or less, is formed a cristobalite crystalline layer using doped impurity as crystallisation nucleus. Opt. the impurity is a trivalent cation. Opt. the cristobalite layer is 10-100 microns thick from the surface.  
- USE - For furnace core tubes and crucibles for Si growing single crystals.  
- In an example, natural quartz powder was immersed in HF melt in an electric furnace for 10-12 hrs. to obtain prod. contg. 10 ppm or less OH, moulded into a furnace core tube, and heated under (H)Cl gas flow to control Na and K contents to 0.1 ppm or less for each, and Li to 0.3 ppm. An aq. soln. contg. Al ion was coated on the surface of the tube, and heated at 1300 deg.C. for 10-15 hrs. to give a cristobalite layer 10-100 microns thick covering the entire surface of the tube.(0/1)  
CN - R01666-P  
DRL - 3102-R 1678-D  
IW - QUARTZ GLASS PRODUCT SINGLE CRYSTAL GROW CRUCIBLE OUTER SURFACE CRISTOBALITE CRYSTAL  
IKW - QUARTZ GLASS PRODUCT SINGLE CRYSTAL GROW CRUCIBLE OUTER SURFACE CRISTOBALITE CRYSTAL  
NC - 001  
OPD - 1987-03-26  
ORD - 1988-10-03  
PAW - (SHIN-N) SHIN-ETSU SEKIEI KK  
TI - Quartz glass products for single crystal growing crucibles, etc. - have outer surface of cristobalite crystals

# INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichung

zur selben Patentfamilie gehören

In es Abkürzungen

PCT/EP 02/02395

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
WO 0216677 A	28-02-2002	DE 10041582 A1 WO 0216677 A1	14-03-2002 28-02-2002
US 5389582 A	14-02-1995	US 5053359 A US 6381986 B1 US 6012304 A	01-10-1991 07-05-2002 11-01-2000
EP 0911429 A	28-04-1999	EP 0911429 A1 JP 11171684 A US 6106610 A	28-04-1999 29-06-1999 22-08-2000
US 4102666 A	25-07-1978	DE 1771077 A1 CH 527134 A DE 1696061 A1 FR 2002417 A5 GB 1245027 A NL 6902534 A ,B US 3776809 A US 3927697 A CH 514512 A FR 2005160 A5 GB 1255551 A NL 6904878 A ,B US 3660015 A	13-01-1972 31-08-1972 21-10-1971 17-10-1969 02-09-1971 26-08-1969 04-12-1973 23-12-1975 31-10-1971 05-12-1969 01-12-1971 02-10-1969 02-05-1972

Formblatt PCT/ISA/210 (Anhang Patentfamilie) (Juli 1992)

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/12599

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4102666	A	25-07-1978	DE 1771077 A1	13-01-1972
			CH 527134 A	31-08-1972
			DE 1696061 A1	21-10-1971
			FR 2002417 A5	17-10-1969
			GB 1245027 A	02-09-1971
			NL 6902534 A ,B	26-08-1969
			US 3776809 A	04-12-1973
			US 3927697 A	23-12-1975
			CH 514512 A	31-10-1971
			FR 2005160 A5	05-12-1969
			GB 1255551 A	01-12-1971
			NL 6904878 A ,B	02-10-1969
			US 3660015 A	02-05-1972
EP 0748885	A	18-12-1996	US 5976247 A	02-11-1999
			CN 1149634 A ,B	14-05-1997
			DE 69615282 D1	25-10-2001
			DE 69615282 T2	18-04-2002
			EP 0748885 A1	18-12-1996
			JP 3046545 B2	29-05-2000
			JP 9110590 A	28-04-1997
			SG 50738 A1	20-07-1998
EP 0753605	A	15-01-1997	US 5980629 A	09-11-1999
			CN 1152037 A ,B	18-06-1997
			DE 69609907 D1	28-09-2000
			DE 69609907 T2	21-12-2000
			EP 0753605 A1	15-01-1997
			JP 3054362 B2	19-06-2000
			JP 9110579 A	28-04-1997
			SG 55205 A1	21-12-1998
JP 2002029890	A	29-01-2002	NONE	
JP 63236722	A	03-10-1988	JP 5017179 B	08-03-1993
JP 63236723	A	03-10-1988	JP 1982360 C	25-10-1995
			JP 6008181 B	02-02-1994
WO 02070414	A	12-09-2002	DE 10139648 A1	02-10-2002
			WO 02070414 A1	12-09-2002
			US 2002139143 A1	03-10-2002
WO 0216677	A	28-02-2002	DE 10041582 A1	14-03-2002
			WO 0216677 A1	28-02-2002
EP 0911429	A	28-04-1999	EP 0911429 A1	28-04-1999
			JP 11171684 A	29-06-1999
			US 6106610 A	22-08-2000